

FORM PTO-1390 US DEPARTMENT OF COMMERCE REV. 5-93PATENT AND TRADEMARK OFFICE		ATTORNEYS DOCKET NUMBER <b>P01,0018</b>
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>		U.S. APPLICATION NO. (if known, see 37 CFR 1.5) <b>09/787859</b>
INTERNATIONAL APPLICATION NO. <b>PCT/DE99/03057</b>	INTERNATIONAL FILING DATE <b>23 SEPTEMBER 1999</b>	PRIORITY DATE CLAIMED <b>25 SEPTEMBER 1998</b>
TITLE OF INVENTION <b>CONVERSION OF GFSK-MODULATED SIGNALS INTO QPSK-MODULATED SIGNALS</b>		
APPLICANT(S) FOR DO/EO/US <b>UWE SYDON ET AL</b>		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay.</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</li> </ol> </li> <li>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2))</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>		
<b>Items 11. to 16. below concern other document(s) or information included:</b>		
11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98; (PTO 1449, Prior Art, Search Report, 04 References).		
12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included. (SEE ATTACHED ENVELOPE)		
13. <input checked="" type="checkbox"/> Amendment "A" Prior to Action and Appendix "A". <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.		
14. <input checked="" type="checkbox"/> A substitute specification and substitute specification mark-up.		
15. <input checked="" type="checkbox"/> A change of address letter attached to the Declaration.		
16. <input checked="" type="checkbox"/> Other items or information: <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> Submission of Drawings and drawing changes</li> <li>b. <input checked="" type="checkbox"/> Appointment of Associate Power of Attorney</li> <li>c. <input checked="" type="checkbox"/> EXPRESS MAIL #EL 843728566 US dated March 22, 2001</li> </ol>		

U.S. APPLICATION NO. (if known, see 37 C.F.R. 1.51) <div style="font-size: 2em; font-weight: bold; margin-top: 5px;">09/787859</div>		INTERNATIONAL APPLICATION NO. <b>PCT/DE99/03057</b>		ATTORNEY'S DOCKET NUMBER <b>P01,0018</b>	
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17. <input checked="" type="checkbox"/> The following fees are submitted:  <div style="margin-top: 10px;"> <b>BASIC NATIONAL FEE (37 C.F.R. 1.492(a)(1)-(5):</b>            Search Report has been prepared by the EPO or JPO    \$860.00             International preliminary examination fee paid to USPTO (37 C.F.R. 1.482)    \$690.00             No international preliminary examination fee paid to USPTO (37 C.F.R. 1.482) but international search fee paid to USPTO (37 C.F.R. 1.445(a)(2))    \$710.00             Neither international preliminary examination fee (37 C.F.R. 1.482) nor international search fee (37 C.F.R. 1.445(a)(2)) paid to USPTO    \$1000.00             International preliminary examination fee paid to USPTO (37 C.F.R. 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$ 100.00         </div> <div style="text-align: right; margin-top: 10px;"> <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b> </div>				CALCULATIONS		PTO USE ONLY																																																																							
<div style="margin-top: 10px;">             Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).           </div> <table border="1" style="width:100%; border-collapse: collapse; margin-top: 5px;"> <tr> <th style="width:20%;">Claims</th> <th style="width:20%;">Number Filed</th> <th style="width:10%;">Number Extra</th> <th style="width:10%;">Rate</th> <th style="width:10%;"></th> <th style="width:10%;"></th> </tr> <tr> <td>Total Claims</td> <td>19                      - 20 =</td> <td>0</td> <td>X \$ 18.00</td> <td>\$</td> <td></td> </tr> <tr> <td>Independent Claims</td> <td>02                      - 3 =</td> <td>0</td> <td>X \$ 80.00</td> <td>\$</td> <td></td> </tr> <tr> <td colspan="3">Multiple Dependent Claims</td> <td>\$270.00 +</td> <td>\$</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right;"><b>TOTAL OF ABOVE CALCULATIONS =</b></td> <td>\$ 860.00</td> <td></td> </tr> <tr> <td colspan="4">Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 C.F.R. 1.9, 1.27, 1.28)</td> <td>\$</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right;"><b>SUBTOTAL =</b></td> <td>\$ 860.00</td> <td></td> </tr> <tr> <td colspan="4">Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).                      +</td> <td>\$</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right;"><b>TOTAL NATIONAL FEE =</b></td> <td>\$ 860.00</td> <td></td> </tr> <tr> <td colspan="4">Fee for recording the enclosed assignment (37 C.F.R. 1.21(h). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). \$40.00 per property                      +</td> <td></td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right;"><b>TOTAL FEES ENCLOSED =</b></td> <td>\$ 860.00</td> <td></td> </tr> <tr> <td colspan="4" rowspan="2"></td> <td style="text-align: center;">Amount to be refunded</td> <td style="text-align: center;">\$</td> </tr> <tr> <td style="text-align: center;">charged</td> <td style="text-align: center;">\$</td> </tr> </table>				Claims	Number Filed	Number Extra	Rate			Total Claims	19                      - 20 =	0	X \$ 18.00	\$		Independent Claims	02                      - 3 =	0	X \$ 80.00	\$		Multiple Dependent Claims			\$270.00 +	\$		<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$ 860.00		Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 C.F.R. 1.9, 1.27, 1.28)				\$		<b>SUBTOTAL =</b>				\$ 860.00		Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).                      +				\$		<b>TOTAL NATIONAL FEE =</b>				\$ 860.00		Fee for recording the enclosed assignment (37 C.F.R. 1.21(h). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). \$40.00 per property                      +						<b>TOTAL FEES ENCLOSED =</b>				\$ 860.00						Amount to be refunded	\$	charged	\$
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a. ☒ A check in the amount of \$ 860.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-1519. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive (37 C.F.R. 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

**SEND ALL CORRESPONDENCE TO:**

**SCHIFF HARDIN & WAITE**  
**PATENT DEPARTMENT**  
**6600 Sears Tower**  
**233 South Wacker Drive**  
**Chicago, Illinois 60606-6473**

**CUSTOMER NUMBER 26574**

SIGNATURE

Mark Bergner

NAME

45,877

Registration Number

09/787859

**BOX PCT  
IN THE UNITED STATES DESIGNATED/ELECTED OFFICE  
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE  
UNDER THE PATENT COOPERATION TREATY-CHAPTER II**

**CHANGE OF ADDRESS OF APPLICANTS' REPRESENTATIVE**

APPLICANT(S): UWE SYDON ET AL.  
ATTORNEY DOCKET NO.: P01,0018  
INTERNATIONAL APPLICATION NO: PCT/DE99/03057  
INTERNATIONAL FILING DATE: 23 September 1999  
INVENTION: CONVERSION OF GFSK-MODULATED SIGNALS INTO QPSK-MODULATED SIGNALS

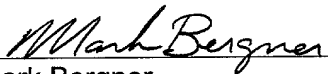
Assistant Commissioner for Patents,  
Washington D.C. 20231

S I R:

Members of the firm of Hill & Simpson designated on the original Power of Attorney have merged into the firm of Schiff Hardin & Waite. All future correspondence for the above-referenced application therefore should be sent to the following address:

**SCHIFF HARDIN & WAITE  
Patent Department  
6600 Sears Tower  
233 South Wacker Drive  
Chicago, Illinois 60606-6473  
CUSTOMER NUMBER 26574**

Submitted by,

  
Mark Bergner (Reg. No. 45,877)  
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Patent Department  
6600 Sears Tower  
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CUSTOMER NUMBER 26574

09/787859

BOX PCT  
IN THE UNITED STATES DESIGNATED/ELECTED OFFICE  
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE  
UNDER THE PATENT COOPERATION TREATY--CHAPTER II

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**PRELIMINARY AMENDMENT A**  
**PRIOR TO ACTION**

APPLICANT(S): UWE SYDON ET AL  
ATTORNEY DOCKET NO.: P01,0018  
INTERNATIONAL APPLICATION NO: PCT/DE99/03057  
INTERNATIONAL FILING DATE: 23 SEPTEMBER 1999  
INVENTION: CONVERSION OF GFSK-MODULATED SIGNALS  
INTO QPSK-MODULATED SIGNALS

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Assistant Commissioner for Patents,  
Washington D.C. 20231

Sir:

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Applicants herewith amend the above-referenced PCT application, and  
request entry of the Amendment prior to examination on the United States  
Examination Phase.

**IN THE CLAIMS:**

20

**On page 12:**

replace line 1 with --WHAT IS CLAIMED IS--;

Please replace original claims 1-19 with the following rewritten claims 1-19,  
referring to the mark-ups in Appendix A.

25

1. (Amended) A mobile radiotelephone device for a wireless transmission of  
QPSK-modulated data, comprising:

a controller that is designed for a transmission of GFSK-modulated data, and  
an adaptor module that converts GFSK-modulated data output by the  
controller into QPSK-modulated data to be transmitted or, respectively, that converts

received, QPSK-modulated data into GFSK-modulated data and gives them to the controller.

2. (Amended) The mobile radiotelephone device according to claim 1,  
5 wherein the adaptor module outputs a synchronization signal to the controller in synchronized conditions.

3. (Amended) The mobile radiotelephone device according to claim 1,  
10 wherein the controller is a DECT controller.

4. (Amended) The mobile radiotelephone device according to claim 1,  
wherein the adaptor module synchronizes to a received, QPSK-modulated signal.

5. (Amended) The mobile radiotelephone device according to claim 4,  
15 wherein the adaptor module time-shifts the synchronization received signal for the controller dependent on its synchronization onto the QPSK-modulated signal.

6. (Amended) The mobile radiotelephone device according to claim 1, further  
20 comprising an RF module driven by the adaptor module such that the data are modulated onto a carrier frequency that lies outside the DECT band.

7. (Amended) The mobile radiotelephone device according to claim 6,  
wherein the carrier frequency lies in a 2.4 GHz band.

8. (Amended) The mobile radiotelephone device according to claim 1,  
25 wherein the adaptor module is an ASIC.

9. (Amended) The mobile radiotelephone device according to claim 1,  
wherein the adaptor module converts GFSK-modulated data into  $\pi/4$  QPSK-

modulated data or, respectively, converts received  $\pi/4$  QPSK-modulated data into GFSK-modulated data.

10. (Amended) A method for the wireless transmission of QPSK-modulated  
5 data with a controller that is designed for a transmission of GFSK-modulated data,  
comprising the step of:

converting, by an adaptor module, GFSK-modulated data output by the  
controller into QPSK-modulated data to be transmitted or, respectively, converting,  
by the adaptor module, received, QPSK-modulated data into GFSK-modulated data  
10 and gives the GFSK-modulated data to the controller.

11. (Amended) A method for the wireless transmission of QPSK-modulated  
data according to claim 10, further comprising the step of outputting, by the adaptor  
module, a synchronization signal to the controller in a synchronized condition.  
15

12. (Amended) The method according to claim 11, wherein the controller is a  
DECT controller.

13. (Amended) The method according to claim 10, further comprising the  
20 step of self-synchronizing by the adaptor module from a received, QPSK-modulated  
signal.

14. (Amended) The method according to claim 13, further comprising the  
step of time-shifting, by the adaptor module, the synchronization signal for the  
25 controller dependent on its synchronization onto the QPSK-modulated signal.

15. (Amended) The method according to according to claim 10, further  
comprising the step of driving, by the adaptor module, an RF module such that the  
data are modulated onto a carrier frequency that lies outside the DECT band.  
30

16. (Amended) The method according to according to claim 15, wherein the carrier frequency lies in a 2.4 GHz band.

17. (Amended) The method according to according to claim 10, wherein the  
5 adaptor module converts GFSK-modulated data into pi/4 QPSK-modulated data or, respectively, converts received pi/4 QPSK-modulated data into GFSK-modulated data.

18. (Amended) The method according to claim 10, further comprising the  
10 step of changing the carrier frequency after a predetermined time duration.

19. (Amended) The method according to claim 18, wherein the carrier frequency is changed after a time slot or a frame of a transmission.

#### REMARKS

The present Amendment revises the specification and claims to conform to United States patent practice, before examination of the present PCT application in the United States National Examination Phase. Pursuant to 37 CFR 1.125 (b),  
20 applicants have concurrently submitted a substitute specification, excluding the claims, and provided a marked-up copy. All of the changes are editorial and applicant believes no new matter is added thereby. The amendment, addition, and/or cancellation of claims is not intended to be a surrender of any of the subject matter of those claims.

Early examination on the merits is respectfully requested.

Submitted by,

5

Mark Bergner

(Reg. No. 45,877)

Mark Bergner  
Schiff Hardin & Waite  
Patent Department  
6600 Sears Tower  
233 South Wacker Drive  
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(312) 258-5779  
Attorneys for Applicant

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**CUSTOMER NUMBER 26574**



Appendix A  
Mark Ups for Claim Amendments

This redlined draft, generated by CompareRite (TM) - The Instant Redliner, shows the differences between -

original document : Q:\DOCUMENTS\YEAR 2001\P010018-SYDON-  
CONVERSION OF GFSK SIGS\ORIGINAL CLAIMS.DOC  
and revised document: Q:\DOCUMENTS\YEAR 2001\P010018-SYDON-  
CONVERSION OF GFSK SIGS\AMENDED CLAIMS.DOC

CompareRite found 80 change(s) in the text

Deletions appear as Overstrike text surrounded by []  
Additions appear as Bold-Underline text

1. ~~[Mobile]~~**(Amended) A mobile** radiotelephone device for ~~[the]~~ a wireless transmission of QPSK-modulated data, comprising:

~~[--]~~a controller ~~[(22)]~~ that is designed for a transmission of GFSK-modulated data, and

~~[--]~~an adaptor module ~~[(23)]~~ that converts GFSK-modulated data output by the controller ~~[(22)]~~ into QPSK-modulated data to be transmitted or, respectively, that converts received, QPSK-modulated data into GFSK-modulated data and gives them to the controller~~[(23)]~~.

2. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to claim 1, ~~[characterized in that]~~ **wherein** the adaptor module ~~[(23)]~~ outputs a synchronization signal to the controller ~~[(22)]~~ in ~~[the]~~ synchronized conditions.

3. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to claim 1 ~~[or 2, characterized in that]~~, **wherein** the controller is a DECT controller~~[(22)]~~.

4. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to ~~[one of the claims 1, 2 or 3, characterized in that]~~ **claim 1, wherein** the adaptor module ~~[(23)]~~ synchronizes to a received, QPSK-modulated signal.

5. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to claim 4, ~~[characterized in that]~~ **wherein** the adaptor module ~~[(23)]~~ time-shifts the synchronization **received** signal for the controller ~~[(22)]~~ dependent on its synchronization onto the QPSK-modulated signal.

6. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to ~~[one of the preceding claims, characterized in that]~~ **claim 1, further comprising an RF module driven by** the adaptor module ~~[(23) drives an RF module (4, 5)]~~ such that the data are modulated onto a carrier frequency ~~[fx]~~ that lies outside the DECT band.

7. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to claim 6, ~~[characterized in that]~~ **wherein** the carrier frequency ~~[fx]~~ lies in a 2.4 GHz band.

8. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to ~~[one of the preceding claims, characterized in that]~~ **claim 1, wherein** the adaptor module is an ASIC~~[(23)]~~.

9. ~~[Mobile]~~**(Amended) The mobile** radiotelephone device according to ~~[one of the preceding claims, characterized in that]~~ **claim 1, wherein** the adaptor module ~~[(23)]~~ converts GFSK-modulated data into pi/4 QPSK-modulated data or, respectively, converts received pi/4 QPSK-modulated data into GFSK-modulated data.

10. ~~[Method]~~**(Amended) A method** for the wireless transmission of QPSK-modulated data with a controller ~~[(22)]~~ that is designed for a transmission of GFSK-modulated data, ~~[whereby]~~ **comprising the step of:**

**converting, by** an adaptor module~~[(23) converts]~~, GFSK-modulated data output by the controller ~~[(22)]~~ into QPSK-modulated data to be transmitted or, respectively, ~~[converts]~~ **converting, by the adaptor module,** received, QPSK-

modulated data into GFSK-modulated data and gives ~~them~~ **the GFSK-modulated data** to the controller{(23)}.

11. ~~[Method]~~**(Amended) A method** for the wireless transmission of QPSK-modulated data according to claim 10, ~~[characterized in that]~~ **further comprising the step of outputting, by** the adaptor module{(23)-outputs}, a synchronization signal to the controller {(22)} in ~~the~~ **a** synchronized condition.

12. ~~[Method]~~**(Amended) The method** according to claim 11, ~~[characterized in that]~~ **wherein** the controller is a DECT controller{(22)}.

13. ~~[Method]~~**(Amended) The method** according to ~~[one of the claims 11 or 12, characterized in that]~~ **claim 10, further comprising the step of self-synchronizing by** the adaptor module {(23)-synchronized itself} from a received, QPSK-modulated signal.

14. ~~[Method]~~**(Amended) The method** according to claim 13, ~~[characterized in that]~~ **further comprising the step of time-shifting, by** the adaptor module{(23)-time-shifts}, the synchronization signal for the controller {(22)} dependent on its synchronization onto the QPSK-modulated signal.

15. ~~[Method]~~**(Amended) The method** according to according to ~~[one of the preceding claims, characterized in that]~~ **claim 10, further comprising the step of driving, by** the adaptor module{(23)-drives}, an RF module {(4, 5)} such that the data are modulated onto a carrier frequency  $[f_x]$  that lies outside the DECT band.

16. ~~[Method]~~**(Amended) The method** according to according to claim 15, ~~[characterized in that]~~ **wherein** the carrier frequency  $[f_x]$  lies in a 2.4 GHz band.

17. ~~[Method]~~**(Amended) The method** according to ~~according to [one of the~~  
claims 10 through 16, characterized in that] **claim 10, wherein** the adaptor module  
[(23)] converts GFSK-modulated data into  $\pi/4$  QPSK-modulated data or,  
respectively, converts received  $\pi/4$  QPSK-modulated data into GFSK-modulated  
5 data.

18. ~~[Method]~~**(Amended) The method** according to ~~[one of the claims 10~~  
through 17, characterized in that] **claim 10, further comprising the step of**  
**changing** the carrier frequency ~~[ $f_x$  is changed]~~ after a predetermined time duration.

19. ~~[Method]~~**(Amended) The method** according to claim 18, ~~[characterized~~  
in that] **wherein** the carrier frequency  $f_x$  is changed after a time slot ~~[( $Z_x$ )]~~ or a  
frame of ~~[the]~~ **a** transmission.

09/787859

JC10 Rec'd PCT/PTO 22 MAR 2001

BOX PCT  
IN THE UNITED STATES DESIGNATED/ELECTED OFFICE  
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE  
UNDER THE PATENT COOPERATION TREATY--CHAPTER II

**REQUEST FOR APPROVAL OF DRAWING CHANGES**

APPLICANT(S): UWE SYDON ET AL.  
ATTORNEY DOCKET NO.: P01,0018  
INTERNATIONAL APPLICATION NO: PCT/DE99/03057  
INTERNATIONAL FILING DATE: 23 September 1999  
INVENTION: CONVERSION OF GFSK-MODULATED SIGNALS INTO QPSK-MODULATED SIGNALS

Assistant Commissioner for Patents,  
Washington, D.C. 20231

Sir:

Enclosed is one sheet of drawings showing in red, changes to Figure 1.

Approval of the changes is respectfully requested.

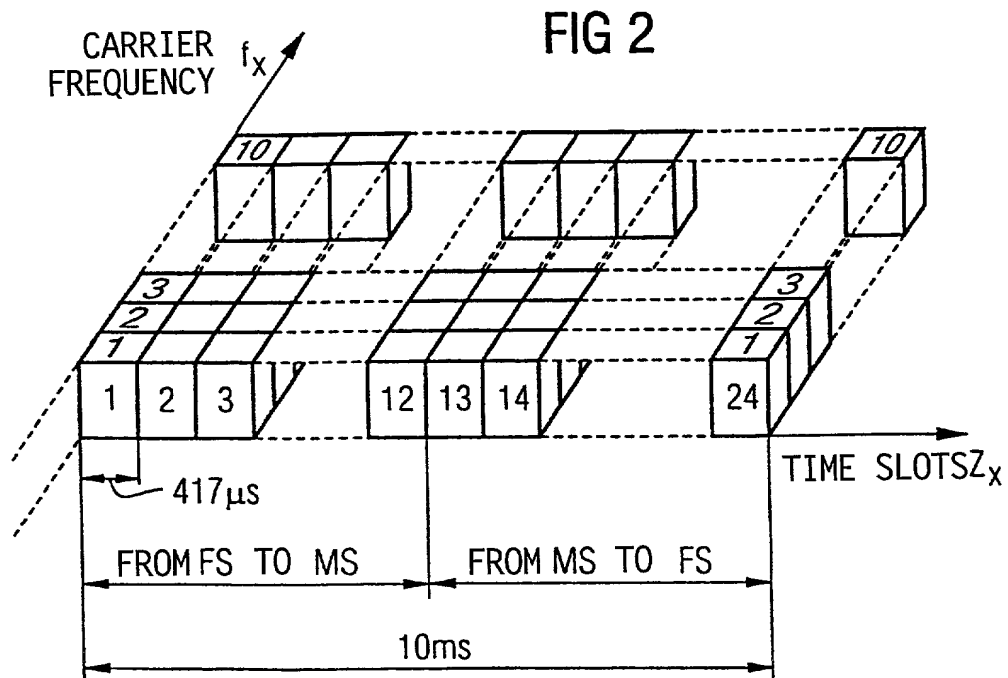
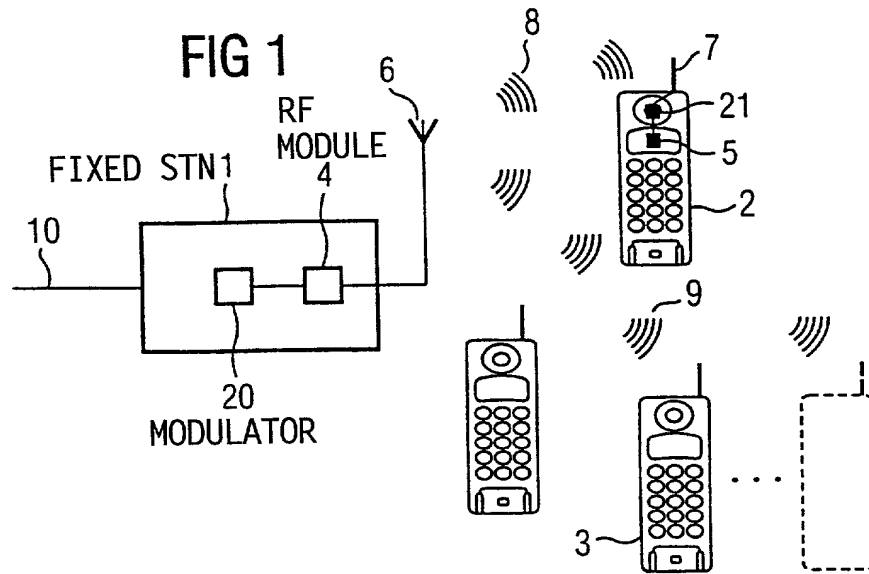
Submitted by,



(Reg. No. 45,877)

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(312) 258-5779  
Attorney for Applicant(s)

**CUSTOMER NUMBER 26574**



## SPECIFICATION

## TITLE

## CONVERSION OF GFSK-MODULATED SIGNALS INTO QPSK-MODULATED SIGNALS

5

## BACKGROUND OF THE INVENTION

## Field of the Invention

1 The present invention is directed to a mobile radiotelephone device and to a method for the wireless transmission of QPSK-modulated data upon employment of a DECT baseband controller.

## 10 Description of the Related Art

2 The DECT standard was enacted at the start of the 1990's in order to replace the existing, different analog and digital standards in Europe. It is the first common European standard for cordless telecommunication. A DECT network is a micro-cellular, digital mobile radiotelephone network for high subscriber densities. It is  
15 mainly designed for use in buildings, but use of the DECT standard outdoors is likewise possible. The capacity of the DECT network of approximately 10,000 subscribers per square kilometer turns the cordless standard into an ideal access technology for network operators. Both the transmission of voice as well as the transmission of data signals is possible according to the DECT standard. Thus,  
20 cordless data networks can also be constructed on the DECT basis.

3 The DECT standard is described in greater detail below on the basis of Figure 2. A digital, cordless telecommunication system for ranges below 300 m was standardized for Europe under the designation DECT (Digital Cordless European Communication). In combination with the switching function of a telecommunication  
25 system, thus, this system is suitable for mobile telephone and data traffic in an office building or on a company campus. The DECT functions supplement a telecommunication system and thus turn it into the fixed station FS of the cordless telecommunication system. Digital radio connections between the fixed station FS and the maximum of 120 mobile stations MS can be set up, monitored and  
30 controlled up to 120 channels.

4       Transmission is carried out in the frequency range 1.88 GHz through 1.9 GHz on a maximum of ten different carrier frequencies (carriers). This frequency-division multiplex method is referred to as FDMA (Frequency Division Multiple Access).

5       The data in the DECT standard are modulated according to the GMSK  
5       method (Gauss Minimum Shift Keying).

6       Twelve channels are transmitted in chronological succession in the time-division multiplex method TDMA (Time Division Multiple Access) on each of the twelve carrier frequencies. A total of 120 channels thus derive for the cordless telecommunication according to the DECT standard given ten carrier frequencies  
10       and respectively twelve channels per carrier frequency. Since, for example, one channel is required for each voice connection, 120 connections to a maximum of 120 mobile stations MS derive. Work on the carriers is in alternating mode (duplex, TTD). After the twelve channels (channels 1-12) have been sent, a switch is made to reception and the twelve channels (channels 13-24) are received in the opposite  
15       direction.

7       A time-division multiplex frame is thus composed of 24 channels (see Figure 2). Channel 1 through channel 12 are thereby transmitted from the fixed station FS to the mobile station MS, whereas channel 13 through channel 24 are transmitted in the opposite direction from the mobile station MS to the fixed station FS. The frame  
20       duration is 10 ms. The duration of a channel (time slot, slot) is 417  $\mu$ s. In this time, 320 bits of information (for example, voice) and 100 bits of control data (synchronization, signaling and error monitoring) are transmitted. The payload bit rate for a subscriber (channel) derives from the 320 bits of information within 10 ms, and is thus 32 kilobits per second.

25       In addition to the previously mentioned 320 information bits, each time slot in the DECT standard contains another 104 bits required for the signal transmission as well as 56 bits of a guard field, so that each time slot contains a total of 480 bits.

8       For countries outside Europe, the DECT standard may have to be potentially modified and adapted to the local conditions. For example, in the USA the



transmission cannot ensue in the normal DECT range between 1.88 and 1.90 GHz; on the contrary, the generally accessible 2.4 GHz ISM band (Industrial, Scientific and Medical) is available. Furthermore, modifications must be undertaken for adaptation to the national regulations such as the American regulation FCC part 15.

5 This American regulation describes the transmission methods, transmission powers and the available bandwidth that are allowed for the air interface. A use of DECT is not allowed in this band since the bandwidth of DECT (1.2 MHz) exceeds the allowable bandwidth of 1.0 MHz.

9 In addition, FCC part 15 prescribes how much transmission power is allowed  
10 to be transmitted on a specific channel during a specific time duration. This regulation would also not be satisfied by a direct transfer of the DECT standard.

10 One possibility for realizing an air interface that satisfies these rules is to use a higher-grade modulation method, a QPSK-based system in which the carrier frequency is changed at predetermined time intervals (Frequency Hopping Spread  
15 Spectrum). For example, the employment of the higher-grade modulation method halves the required bandwidth when using a QPSK system.

11 One problem arises when controller ICs that exist for the cost-beneficial realization of the air interface and that are designed for the DECT standard are used since, as known, the data in the DECT standard are modulated onto the carrier  
20 frequency according to a GFSK (Gauss Frequency Shift Keying) system.

### BRIEF SUMMARY OF THE INVENTION

12 The object of the present invention is therefore to offer a mobile radiotelephone device and a method that make it possible to create a QPSK air  
25 interface using an existing DECT controller.

13 This object is achieved by a mobile radiotelephone device for a wireless transmission of QPSK-modulated data, comprising: a controller (which may be a DECT controller) that is designed for a transmission of GFSK-modulated data, and an adaptor module that converts GFSK-modulated data output by the controller into

QPSK-modulated data to be transmitted or, respectively, that converts received, QPSK-modulated data into GFSK-modulated data and gives them to the controller. In this device, the adaptor module can be configured to output a synchronization signal to the controller in synchronized conditions. The adaptor module (which may  
5 be an ASIC) can be configured to synchronize to a received, QPSK-modulated signal. Furthermore, the adaptor module can time-shift the synchronization received signal for the controller dependent on its synchronization onto the QPSK-modulated signal. The inventive device may further comprise an RF module driven by the adaptor module such that the data are modulated onto a carrier frequency that lies  
10 outside the DECT band, such as the 2.4 GHz band. The adaptor module can be configured to convert GFSK-modulated data into  $\pi/4$  QPSK-modulated data or, respectively, converts received  $\pi/4$  QPSK-modulated data into GFSK-modulated data.

14 This object is also achieved by a method for the wireless transmission of  
15 QPSK-modulated data with a controller (which may be a DECT controller) that is designed for a transmission of GFSK-modulated data, comprising the step of converting, by an adaptor module, GFSK-modulated data output by the controller into QPSK-modulated data to be transmitted or, respectively, converting, by the adaptor module, received, QPSK-modulated data into GFSK-modulated data and  
20 gives the GFSK-modulated data to the controller. The adaptor model in this method can output a synchronization signal to the controller in a synchronized condition. A step of self-synchronizing by the adaptor module from a received, QPSK-modulated signal may be provided. In the method, the adaptor model may time-shift the synchronization signal for the controller dependent on its synchronization onto the  
25 QPSK-modulated signal. An RF module may be driven by the adaptor module such that the data are modulated onto a carrier frequency that lies outside the DECT band (e.g., 2.4 GHz). The adaptor module may convert GFSK-modulated data into  $\pi/4$  QPSK-modulated data or, respectively, convert received  $\pi/4$  QPSK-modulated data into GFSK-modulated data. The carrier frequency may be changed after a  
30 predetermined time duration (which may be a time slot or a frame of a transmission).

15 The invention is described below in greater detail.

16 According to the invention, thus, a mobile radiotelephone device is provided  
for the wireless transmission of QPSK data. The mobile radiotelephone device  
comprises a controller that is designed and developed for a transmission of GFSK-  
5 modulated data, for example, according to the DECT standard. According to the  
invention, an adaptor module is provided that converts GFSK-modulated data output  
by the controller into QPSK-modulated data to be transmitted, or that converts the  
received QPSK-modulated data into GFSK-modulated data and gives them to the  
controller.

10 17 The adaptor module must thereby be designed such that it assures a  
synchronization of the QPSK-modulated data after the conversion of the QPSK-  
modulated data into GFSK-modulated data according to the DECT standard, which  
can ensue with a synchronization signal from the adaptor module to the controller.

15 18 The adaptor module can drive an RF module such that the data are  
modulated onto a carrier frequency  $f_x$  that lies outside the DECT band. For  
example, the carrier frequency can lie in a 2.4 GHz band (ISM band).

19 The adaptor module can be implemented with an ASIC, and can convert  
GFSK-modulated data into  $\pi/4$ -QPSK-modulated data, or received  $\pi/4$ -QPSK-  
modulated data into GFSK-modulated data.

20 20 According to the invention, furthermore, a method is provided for the wireless  
transmission of QPSK-modulated data with a controller that is designed for a  
transmission of GFSK-modulated data, for example, according to the DECT  
standard. An adaptor module converts GFSK-modulated data output by the  
controller into QPSK-modulated data to be transmitted, or converts received QPSK-  
25 modulated data into GFSK-modulated data and gives them to the controller.

21 According to the invention, the carrier frequency  $f_x$  can be changed after a  
predetermined time duration, where the predetermined time duration can be a time  
slot or a frame (or a multiple thereof) of the DECT time frame.

## BRIEF DESCRIPTION OF THE DRAWINGS

22 The invention is explained in greater detail on the basis of an exemplary embodiment and with reference to the accompanying drawings.

- 5 Figure 1 is a schematic block diagram of an inventive arrangement for the digital radio transmission of data;
- Figure 2 is a schematic illustration of the known DECT standard;
- Figure 3 is a phase state diagram of the QPSK modulation;
- Figure 4 is a state transition diagram of the  $\pi/4$  DQPSK modulation;
- 10 Figure 5 is a detailed block diagram illustrating a portion of an inventive mobile radiotelephone device; and
- Figure 6 is a block diagram showing a development of the device according to Figure 5 in which an adaptor module forwards a synchronization signal to the controller.

## 15 DETAILED DESCRIPTION OF THE INVENTION

- 23 An arrangement for the digital radio transmission of data is provided in Figure 1. A fixed station 1 is connected to the fixed network with a terminal line 10. The fixed station 1 comprises an RF module 4 with which data can be transmitted or received with an antenna 6.
- 20 24 A radio transmission to a mobile station 2 via a radio transmission link 8 or a radio transmission to a mobile station (cordless telephone) 3 via a second radio transmission link 9 can ensue with the antenna 6. All mobile stations shown in Figure 1 have the same structure, so that a more detailed explanation only refers to the illustrated mobile station 2.
- 25 25 As can be seen in Figure 1, this mobile station 2 comprises an antenna 7 for the reception or, respectively, for the transmission of data from or, respectively, to the fixed station 1. An RF module 5 that essentially corresponds to the RF module 4 employed in the fixed station 1 is provided in the mobile station 2.

26 A modulator 20 is provided in the fixed station 1, whose exact function is explained below. A demodulator 21 (Figure 5) in the mobile station 2 implements the inverse function with respect to that of the modulator 20. Moreover, the fixed station 1 as well as each mobile station 2, 3 respectively comprise a modulator and  
5 a demodulator, as known from radio transmission systems.

27 As already initially mentioned, the present invention is intended to create an air interface in order to adapt the known DECT standard to the regulations that apply to the American ISM band. The problem is that the baseband width of 1.2 MHz that is required according to the DECT standard for offering the bit rate of 1.152  
10 megabits per second exceeds the maximum baseband width of 1 MHz prescribed by the American rule FCC part 15. A higher-grade modulation method is therefore employed. In the sense of the present specification, a high-grade modulation method (compared to the GMSK modulation method of the DECT standard) is a modulation method in which more than two (i.e., 4, 8, ...) discrete carrier states are  
15 present and, thus, at least two bits are combined to form a symbol and are transmitted together as symbol in one step.

28 For example, quadrature phase shift keying QPSK (4 PSK), which is shown in Figure 3, is thus a higher-grade modulation method in this sense. According to the QPSK modulation method, the input data are offered as bipolar pulses, i.e., the  
20 logical 1 is represented by +1 and the logical 0 is represented by -1. With serial/parallel conversion, the serial data stream is first divided into bits of even-numbered and odd-numbered position. After this conversion, two data signals are present having respectively half the data rate of the original signal.

29 Another example of a higher-grade modulation method is the  $\pi/4$  DQPSK  
25 modulation method shown in Figure 4. The goal of this modulation method is to avoid phase skips of  $180^\circ$  that lead to amplitude fades. To that end, respectively two bits are combined to form a symbol and effect a phase skip of  $\pm 45^\circ$  or  $\pm 135^\circ$  compared to the last transmission phase, as shown in the state transition diagram of Figure 4.

30 The 8 PSK or the 16 PSK modulation method can be cited as further  
examples of higher-grade modulation methods, in which 8 or, respectively, 16  
discrete carrier states are present and, thus, 3 or, respectively, 4 bits are combined  
to form a symbol and are transmitted.

5 31 What all digital modulation methods have in common is that the transmission  
bandwidth becomes smaller with an increasing  $m$ , i.e., with an increasing plurality of  
carrier states, and given an unchanging bit rate, since  $N=1d(m)$  bits are always  
combined to form a symbol and are transmitted as a common symbol in a single  
step. In the present case, this means, that the bit rate of the DECT standard can be  
10 retained as a result of the higher-grade modulation method, and, at the same time,  
the transmission baseband width is smaller than the maximum value prescribed by  
FCC part 15. Due to the combining of at least two bits, for example, the baseband  
width can be halved given an unaltered bit rate.

32 Component parts developed and produced for the DECT standard such as  
15 the DECT baseband controller, can continue to be cost-beneficially employed since  
the time slot and frame structure of the transmission is not modified compared to the  
DECT standard.

33 Parameters of the inventive air interface that can be proven especially  
advantageous are compiled again below in the following table.

Frequency band	2.4 - 2.483 GHz ISM band
Transmission method	Frequency hopping spread spectrum
Access method	FDMA / TDMA
Duplex method	TDD
Number of carrier frequencies	96

Spacing of the carrier frequencies	0.864 MHz
Carrier frequencies (MHz)	$f_n = 2401.056 + nx0$ , whereby $n=0...95$
Number of possible channels	1152
Number of channels that can be simultaneously occupied	12
Transmitted peak power	250 mW (up to 1 Watt possible)
Anticipated range	as in DECT (. 300 m)
Modulation method	2-level modulation, for example $\pi/4$ SQPSK
Frame length	10 ms (5ms, Rx, 5ms Tx)
Number of time slots	24
Bit rate	1152 kbit/s

- 34 The sale of cordless telephones according to the DECT standard is currently essentially limited to European countries since the corresponding frequencies were released there. For an introduction into other countries such as, for example, the
- 5 USA, the above-recited air interface according to the 2.4 GHz ISM band is, for example, required. In this case, of course, some parameters -- as explained above - - must be adapted in view of the rules (FCC part 15) that apply to this band. One possibility of doing this was previously explained. The employment of an existing DECT controller is advantageous for a cost-beneficial realization of such a system
- 10 since economic advantages can be achieved due to the great piece numbers.

Although, as mentioned above, the time slot and frame structure of the transmission need not be modified compared to the DECT standard, it must nonetheless be noted that a GFSK modulation method is employed according to the DECT standard and that there are no DECT systems that employed QPSK-based modulation methods.

5 35 According to the present invention, therefore, the functionality of a suitable module can be defined that makes it possible to convert signals of an existing DECT controller into QPSK-based systems (for example, PWT). This module can be realized, for example, in the form of an ASIC or in any other form. This module must realize the following functions:

- 10 • conversion of GFSK modulation into QPSK (for example,  $\pi/4$ -QPSK) modulation in the transmission case;
- conversion of QPSK (for example,  $\pi/4$ -QPSK) modulation into GFSK modulation;
- drive of the RF module with a corresponding frequency information, i.e.,
- 15 • conversion of the frequency drive of a DECT controller to the demands of the corresponding air interface, and
- generation of the frequency information required by a DECT controller from the actual conditions.

20 36 Figure 5 shows an inventive mobile radiotelephone device that can be a base station or a mobile station. As usual in a transmission according to the DECT standard, a DECT baseband controller 22 is provided. Among other things, this baseband controller 22 comprises a modulator/demodulator. According to the invention, however, an additional adaptor module 23 is provided that, for example, can be realized by an ASIC.

25 37 According to the invention and as can be seen from Figure 5, the DECT baseband controller 22 forwards GFSK-modulated data to the ASIC 23 in the transmission status. This ASIC 23 converts the GFSK-modulated data into QPSK-modulated data and forwards them to the radio frequency module 4, 5. The radio frequency module 4, 5 then outputs these QPSK-modulated data to the antenna 6,



7. The baseband controller 22 is also connected to the adaptor module 23 with a control line 24 that serves for the DECT carrier setting.

38 When the transmission is to ensue in a frequency band other than the DECT frequency band, the ASIC 23 also forwards carrier frequency information  $f_x$  to the radio frequency module 4, 5 with a control line 25 in order to modulate this onto the corresponding carrier frequency. For example, a transmission in the ISM 2.4 GHz band can thus ensue.

39 Upon reception of QPSK-modulated data that the radio frequency module 4, 5 gives to the ASIC 23 and that can also contain a synchronization word in addition to the payload data, the ASIC 23 also forwards synchronization information together with the actual payload data to the DECT baseband controller 22 GFSK-modulated.

40 As can be seen from Figure 6, the GFSK modulator/demodulator 20, 21 of the DECT baseband controller 22 forwards GFSK-modulated data to the ASIC 23 in the transmission condition. The ASIC 23 converts the GFSK-modulated data and gives them to the radio frequency module 4, 5 of the DECT baseband controller. The radio frequency module 4, 5 then outputs these QPSK-modulated data to the antenna 6, 7.

41 When the transmission is to ensue in a frequency band other than the DECT frequency band, the ASIC 23 also forwards carrier frequency information  $f_x$  to the radio frequency module 4, 5 in order to modulate this onto the corresponding carrier frequency. For example, a transmission in the ISM 2.4 GHz band can thus ensue.

42 Upon reception of QPSK-modulated data that the radio frequency module 4, 5 gives to the ASIC 23, the ASIC 23 also forwards synchronization information to the QPSK modulator/demodulator 20, 21 of the DECT baseband controller 22.

43 Given the illustrated arrangement, the problem can arise that the synchronization method as employed in the DECT baseband controller 23 must continue to function, i.e., that the DECT controller must now synchronize to the data stream converted by the adaptor module 23. The QPSK-modulated data are transmitted/received with half the data rate since one QPSK symbol corresponds to

exactly 2 DECT bits. Some DECT bits can thus be lost upon reception, these being required by the DECT baseband controller 22 for the synchronization.

44 According to the present invention and as can be seen in Figure 6, the adaptor module 23 that realizes the conversion between the QPSK and the GFSK  
5 modulation method permanently transmits a DECT synchronization signal (1, 0 sequence) available to the DECT baseband controller 22 in its synchronized condition. The DECT baseband controller 22 can thus synchronize to this sequence of the DECT synchronization signal from the adaptor module 23.

45 A prerequisite for this is that the adaptor module 23 can synchronize to the  
10 received QPSK signal (symbol synchronization). Given a modification of the time position of the synchronization as acquired by the adaptor module 23 on the basis of the received QPSK signal, the time position of the DECT synchronization signal that the adaptor module 23 outputs to the DECT baseband controller is correspondingly adapted. Since only the synchronization word (DECT synchronization signal) need  
15 be slightly shifted in time, a fast synchronization can thus ensue in the "DECT level".

46 According to the present invention, a cost-beneficial module can be created upon employment of a DECT baseband controller according to a QPSK modulation method.

47 The above-described method and device are illustrative of the principles of  
20 the present invention. Numerous modifications and adaptations will be readily apparent to those skilled in this art without departing from the spirit and scope of the present invention.

## ABSTRACT OF THE DISCLOSURE

48 A DECT controller is employed for the transmission with a QPSK modulation  
method. An adaptor module (23) is provided that converts QFSK-modulated data  
5 output by the DECT controller (22) into QPSK data to be transmitted. The adaptor  
module (23) can, for example, be an ASIC. Furthermore, the adaptor module (23)  
can drive an RF module (4, 5) of the DECT controller (23) such that the data, for  
example, are modulated onto a carrier frequency in the 2.4 GHz ISM band. A  
system can thus be created for the 2.4 GHz ISM band that can meet the demands  
10 (FCC part 15) made of this band in that a QPSK modulation is employed and the  
carrier frequency is changed after a predetermined time span (frequency hopping  
spread spectrum system). At the same time, a standard DECT controller can be  
employed in a cost-beneficial way.

CONVERSION OF GFSK-MODULATED SIGNALS INTO QPSK-  
MODULATED SIGNALS

The present invention is directed to a mobile radiotelephone device and to a method for the wireless transmission of QPSK-modulated data upon employment of a DECT baseband controller.

The DECT standard was enacted at the start of the 1990's in order to replace the existing, different analog and digital standards in Europe. It is the first common European standard for cordless telecommunication. A DECT network is a micro-cellular, digital mobile radiotelephone network for high subscriber densities. It is mainly designed for use in buildings. An employment of the DECT standard outdoors, however, is likewise possible. The capacity of the DECT network of approximately 10,000 subscribers per square kilometer turns the cordless standard into an ideal access technology for network operators. Both the transmission of voice as well as the transmission of data signals is possible according to the DECT standard. Thus, cordless data networks can also be constructed on the DECT basis.

The DECT standard shall be described in greater detail below on the basis of Figure 2. A digital, cordless telecommunication system for ranges below 300 m was standardized for Europe under the designation DECT (Digital Cordless European Communication). In combination with the switching function of a telecommunication system, thus, this system is suitable for mobile telephone and data traffic in an office building or on a company campus. The DECT functions supplement a telecommunication system and thus turn it into the fixed station FS of the cordless telecommunication system. Digital radio connections between the fixed station FS and the maximum of 120 mobile stations MS can be set up, monitored and controlled on up to 120 channels.

Transmission is carried out in the frequency range 1.88 GHz through 1.9 GHz on a maximum of ten different carrier frequencies (carriers). This frequency-division multiplex method is referred to as FDMA (Frequency Division Multiple Access).

The data in the DECT standard are modulated according to the GMSK method (Gauss Minimum Shift Keying).

Twelve channels are transmitted in chronological succession in the time-division multiplex method TDMA (Time Division Multiple Access) on each of the twelve carrier frequencies. A total of 120 channels thus derive for the cordless telecommunication according to the DECT standard given ten carrier frequencies and respectively twelve channels per carrier frequency. Since, for example, one channel is required for each voice connection, 120 connections to a maximum of 120 mobile stations MS derive. Work on the carriers is in alternating mode (duplex, TTD). After the twelve channels (channels 1-12) have been sent, a switch is made to reception and the twelve channels (channels 13-24) are received in the opposite direction.

A time-division multiplex frame is thus composed of 24 channels (see Figure 2). Channel 1 through channel 12 are thereby transmitted from the fixed station FS to the mobile station MS, whereas channel 13 through channel 24 are transmitted in the opposite direction from the mobile station MS to the fixed station FS. The frame duration amounts to 10 ms. The duration of a channel (time slot, slot) amounts to 417  $\mu$ s. In this time, 320 bits of information (for example, voice) and 100 bits of control data (synchronization, signalling and error monitoring) are transmitted. The payload bit rate for a subscriber (channel) derives from the 320 bits of information within 10 ms. It thus amounts to 32 kilobits per second.

In addition to the aforementioned 320 information bits, each time slot in the DECT standard contains another 104 bits required for the signal transmission as well as 56 bits of a guard field, so that each time slot contains a total of 480 bits.

For countries outside Europe, the DECT standard may have to be potentially modified and adapted to the local conditions. For example, in the USA the transmission cannot ensue in the normal DECT range between 1.88 and 1.90 GHz; on the contrary, the generally accessible 2.4 GHz ISM band (Industrial, Scientific and Medical) is available. Further, modifications must be undertaken for adaptation to the national regulations such as, for example, the American regulation FCC part 15. Said American regulation describes the transmission methods, transmission powers and the available bandwidth that are allowed for the air interface. A use of DECT is not

allowed in this band since the bandwidth of DECT (1.2 MHz) exceeds the allowable bandwidth of 1.0 MHz.

Over and above this, how much transmission power is allowed to be transmitted on a specific channel during a specific time duration is prescribed in FCC  
5 part 15. This regulation would also not be satisfied by a direct transfer of the DECT standard.

One possibility for realizing an air interface that satisfies said rules is comprised in the employment of a higher-grade modulation method, for of a QPSK-based system wherein the carrier frequency is changed at predetermined time intervals  
10 (Frequency Hopping Spread Spectrum). For example, the employment of the higher-grade modulation method halves the required bandwidth given employment of a QPSK system.

One problem thereby arises when controller ICs that exist for the cost-beneficial realization of the air interface and that are designed for the DECT standard  
15 are to be employed since, as known, the data in the DECT standard are modulated onto the carrier frequency according to a GFSK (Gauss Frequency Shift Keying) system.

The object of the present invention is therefore to offer a mobile radiotelephone device and a method that make it possible to create a QPSK air  
20 interface upon employment of an existing DECT controller.

This object is achieved by the features of the independent claims. The dependent claims develop the central idea of the invention in an especially advantageous way.

According to the invention, thus, a mobile radiotelephone device is  
25 provided for the wireless transmission of QPSK data. The mobile radiotelephone device thereby comprises a controller that is designed and developed for a transmission of GFSK-modulated data, for example according to the DECT standard. According to the invention, an adaptor module is provided that converts GFSK-modulated data output by the controller into QPSK-modulated data to be transmitted  
30 or, respectively, converts the received QPSK-modulated data into GFSK-modulated data and gives them to the controller.

The adaptor module must thereby be designed such that it assures a synchronization of the QPSK-modulated data after the conversion of the QPSK-modulated data into GFSK-modulated data according to the DECT standard, which can ensue with a synchronization signal from the adaptor module to the controller.

5           The adaptor module can thereby drive an RF module such that the data are modulated onto a carrier frequency  $f_x$  that lies outside the DECT band. For example, the carrier frequency can lie in a 2.4 GHz band (ISM band).

The adaptor module can be implemented with an ASIC.

10           The adaptor module can convert GFSK-modulated data into  $\pi/4$ -QPSK-modulated data or, respectively, received  $\pi/4$ -QPSK-modulated data into GFSK-modulated data.

          According to the invention, further, a method is provided for the wireless transmission of QPSK-modulated data with a controller that is designed for a transmission of GFSK-modulated data, for example according to the DECT standard.  
15           An adaptor module thereby converts GFSK-modulated data output by the controller into QPSK-modulated data to be transmitted or, respectively, converts received QPSK-modulated data into GFSK-modulated data and gives them to the controller.

          According to the invention, the carrier frequency  $f_x$  can be changed after a predetermined time duration, whereby the predetermined time duration can be a time slot or a frame (or a multiple thereof) of the DECT time frame.  
20

The invention shall now be explained in greater detail on the basis of an exemplary embodiment and with reference to the accompanying drawings. Shown are:

- Figure 1   an inventive arrangement for the digital radio transmission of data;
- 25   Figure 2   a schematic illustration of the known DECT standard;
- Figure 3   a phase state diagram of the QPSK modulation and
- Figure 4   a state transition diagram of the  $\pi/4$  DQPSK modulation;
- Figure 5   a detailed illustration of a portion of an inventive mobile radiotelephone device;
- 30   Figure 6   a development of the device according to Figure 5 wherein an adaptor module forwards a synchronization signal to the controller.

An arrangement for the digital radio transmission of data is provided in Figure 1. A fixed station 1 is thereby connected to the fixed network with a terminal line 10. The fixed station 1 comprises an RF module 4 with which data can be transmitted or, respectively, received with an antenna 6.

5           A radio transmission to a mobile station 2 via a radio transmission link 8 or, respectively, a radio transmission to a mobile station (cordless telephone) 3 via a second radio transmission link 9 can ensue with the antenna 6. All mobile stations shown in Figure 1 have the same structure, so that a more detailed explanation shall only ensue with reference to the illustrated mobile station 2.

10           As can be seen in Figure 1, this mobile station 2 comprises an antenna 7 for the reception or, respectively, for the transmission of data from or, respectively, to the fixed station 1. An RF module 5 that essentially corresponds to the RF module 4 employed in the fixed station 1 is provided in the mobile station 2.

15           A modulator (referenced 20) is provided in the fixed station 1, the exact function thereof being explained later. A demodulator is referenced 21 in the mobile station 2, this implementing the inverse function with respect to that of the modulator 20. Moreover, it must be pointed out that, of course, the fixed station 1 as well as each mobile station 2, 3 respectively comprise a modulator and a demodulator, as known from radio transmission systems.

20           As already initially mentioned, the present invention is intended to create a possibility of an air interface in order to adapt the known DECT standard to the regulations that apply to the American ISM band. The problem thereby arises that the baseband width of 1.2 MHz that are [sic] required according to the DECT standard for offering the bit rate of 1.152 megabits per second exceeds the maximum baseband  
25           width of 1 MHz prescribed by the American rule FCC part 15. A higher-grade modulation method is therefore employed. In the sense of the present specification, a high-grade modulation method (compared to the GMSK modulation method of the DECT standard) is a modulation method wherein more than two (i.e., 4, 8, ...) discrete carrier states are present and, thus, at least two bits are combined to form a symbol  
30           and are transmitted together as symbol in one step.



For example, quadrature phase shift keying QPSK (4 PSK), which is shown in Figure 3, is thus a higher-grade modulation method in this sense. According to the QPSK modulation method, the input data are offered as bipolar pulses, i.e. the logical 1 is represented by +1 and the logical 0 is represented by -1. With  
 5 serial/parallel conversion, the serial data stream is first divided into bits of even-numbered and odd-numbered position. After this conversion, two data signals are present having respectively half the data rate of the original signal.

Another example of a higher-grade modulation method is the  $\pi/4$  DQPSK modulation method shown in Figure 4. The goal of this modulation method is to  
 10 avoid phase skips of  $180^\circ$  that lead to amplitude fades. To that end, respectively two bits are combined to form a symbol and effect a phase skip of  $\pm 45^\circ$  or  $\pm 135^\circ$  compared to the last transmission phase, as shown in the state transition diagram of Figure 4.

Let the 8 PSK or the 16 PSK modulation method be cited as further  
 15 examples of higher-grade modulation methods, whereby 8 or, respectively, 16 discrete carrier states are present and, thus, 3 or, respectively, 4 bits are combined to form a symbol and are transmitted.

What all digital modulation methods have in common is that the transmission bandwidth becomes smaller with an increasing  $m$ , i.e. with an increasing  
 20 plurality of carrier states, and given an unchanging bit rate, since, of course,  $N=1d(m)$  bits are always combined to form a symbol and are transmitted as common symbol in a single step. In the present case, this means, that the bit rate of the DECT standard can be retained as a result of the higher-grade modulation method, and, at the same  
 25 time, the transmission baseband width is smaller than the maximum value prescribed by FCC part 15. Due to the combining of at least two bits, for example, the baseband width can be halved given an unaltered bit rate.

Component parts developed and produced for the DECT standard such as, for example, the DECT baseband controller, can thereby continue to be cost-  
 30 beneficially employed since the time slot and frame structure of the transmission is not modified compared to the DECT standard.

Parameters of the inventive air interface that can proven especially advantageous are compiled again below in the following table.

5	Frequency band	2.4 - 2.483 GHz ISM band
	Transmission method	Frequency hopping spread spectrum
	Access method	FDMA / TDMA
	Duplex method	TDD
	Number of carrier frequencies	96
10	Spacing of the carrier frequencies	0.864 MHz
	Carrier frequencies (MHz)	$f_n = 2401.056 + n \times 0$ , whereby $n=0 \dots 95$
	Number of possible channels	1152
	Number of channels that can be simultaneously occupied	12
	Transmitted peak power	250 mW (up to 1 Watt possible)
15	Anticipated range	as in DECT ( $\approx 300$ m)
	Modulation method	2-level modulation, for example $\pi/4$ QPSK
	Frame length	10 ms (5ms, Rx, 5ms Tx)
	Number of time slots	24
	Bit rate	1152 kbit/s

The sale of cordless telephones according to the DECT standard is currently essentially limited to European countries since the corresponding frequencies were released there. For an introduction into other countries such as, for example, the USA, the above-recited air interface according to the 2.4 GHz ISM band is, for example, required. In this case, of course, some parameters -- as explained above -- must be adapted in view of the rules (FCC part 15) that apply to this band.

One possibility of doing this was explained above. The employment of existing DECT controller is advantageous for a cost-beneficial realization of such a system since economic advantages can be achieved due to the great piece numbers. Although, as mentioned above, the time slot and frame structure of the transmission need not be modified compared to the DECT standard, it must nonetheless be noted that a GFSK modulation method is employed according to the DECT standard and that there are no DECT systems that employed QPSK-based modulation methods.

According to the present invention, therefore, the functionality of a suitable module should be defined that makes it possible to convert signals of an existing DECT controller into QPSK-based systems (for example, PWT). This module can be realized, for example, in the form of an ASIC or in any other form.

5 This module must thereby realize the following functions:

- conversion of GFSK modulation into QPSK (for example,  $\pi/4$ -QPSK) modulation in the transmission case;
- conversion of QPSK (for example,  $\pi/4$ -QPSK) modulation into GFSK modulation;
- 10 -- drive of the RF module with a corresponding frequency information, i.e.
  - conversion of the frequency drive of a DECT controller to the demands of the corresponding air interface, and
  - generation of the frequency information required by a DECT controller from the actual conditions.

15 The invention shall now be explained in detail with reference to Figure 5. Figure 5 shows a mobile radiotelephone device that can be a base station or a mobile station. As usual in a transmission according to the DECT standard, a DECT baseband controller 22 is thereby provided. Among other things, this baseband controller 22 comprises a modulator/demodulator. According to the invention, however, an additional adaptor module 23 is provided that, for example, can be realized by an ASIC.

According to the invention and as can be seen from Figure 5, the DECT baseband controller 22 forwards GFSK-modulated data to the ASIC 23 in the transmission status. This ASIC 23 converts the GFSK-modulated data into QPSK-modulated data and forwards them to the radiofrequency module 4, 5. The radiofrequency module 4, 5 then outputs these QPSK-modulated data to the antenna 6, 7. The baseband controller 22 is also connected to the adaptor module 23 with a control line 24 that serves for the DECT carrier setting.

When the transmission is to ensue in a frequency band other than the DECT frequency band, the ASIC 23 also forwards carrier frequency information  $f_x$  to the radiofrequency module 4, 5 with a control line 25 in order to modulate this onto

the corresponding carrier frequency. For example, a transmission in the ISM 2.4 GHz band can thus ensue.

Upon reception of QPSK-modulated data that the radiofrequency module 4, 5 gives to the ASIC 23 and that can also contain a synchronization word in addition to the payload data, the ASIC 23 also forwards synchronization information together with the actual payload data to the DECT baseband controller 22 GFSK-modulated.

As can be seen from Figure 6, the GFSK modulator/demodulator 20, 21 of the DECT baseband controller 22 forwards GFSK-modulated data to the ASIC 23 in the transmission condition. The ASIC 23 converts the GFSK-modulated data and gives them to the radiofrequency module 4, 5 of the DECT baseband controller. The radiofrequency module 4, 5 then outputs these QPSK-modulated data to the antenna 6, 7.

When the transmission is to ensue in a frequency band other than the DECT frequency band, the ASIC 23 also forwards carrier frequency information  $f_x$  to the radiofrequency module 4, 5 in order to modulate this onto the corresponding carrier frequency. For example, a transmission in the ISM 2.4 GHz band can thus ensue.

Upon reception of QPSK-modulated data that the radiofrequency module 4, 5 gives to the ASIC 23, the ASIC 23 also forwards synchronization information to the QPSK modulator/demodulator 20, 21 of the DECT baseband controller 22.

Given the illustrated arrangement, the problem can thereby arise that the synchronization method as employed in the DECT baseband controller 23 must continue to function, i.e. that the DECT controller must now synchronize to the data stream converted by the adaptor module 23. It must thereby be noted that the QPSK-modulated data are transmitted/received with half the data rate since one QPSK symbol corresponds to exactly 2 DECT bits. Some DECT bits can thus be lost upon reception, these being required by the DECT baseband controller 22 for the synchronization.

According to the present invention and as can be seen in Figure 6, the adaptor module 23 that realizes the conversion between the QPSK and the GFSK modulation method permanently transmits [sic] a DECT synchronization signal (1, 0

sequence) available to the DECT baseband controller 22 in its synchronized condition. The DECT baseband controller 22 can thus synchronize to this sequence of the DECT synchronization signal from the adaptor module 23.

5 A prerequisite therefor is that the adaptor module 23 can synchronize to the received QPSK signal (symbol synchronization). Given a modification of the time position of the synchronization as acquired by the adaptor module 23 on the basis of the received QPSK signal, the time position of the DECT synchronization signal that the adaptor module 23 outputs to the DECT baseband controller, correspondingly, is correspondingly [sic] adapted. Since, thus, only the  
10 synchronization word (DECT synchronization signal) need by slightly shifted in time, a fast synchronization can thus ensue in the "DECT level".

According to the present invention, thus, a cost-beneficial module can be created upon employment of a DECT baseband controller according to a QPSK modulation method.

**List of Reference Characters**

	1:	fixed station
	2:	mobile station (cordless telephone)
	3:	mobile station
5	4:	RF module fixed station
	5:	RF module base station
	6:	Antenna fixed station
	7:	antenna mobile station
	8:	first radio transmission link
10	9:	second radio transmission link
	10:	terminal line
	20:	modulator
	21:	demodulator
	22:	baseband controller
15	23:	ASIC module
	24:	control line
	25:	control line
	Zx:	time slots
	$f_x$ :	carrier frequency

### Patent Claims

1. Mobile radiotelephone device for the wireless transmission of QPSK-modulated data, comprising
  - a controller (22) that is designed for a transmission of GFSK-modulated data, and
  - 5 -- an adaptor module (23) that converts GFSK-modulated data output by the controller (22) into QPSK-modulated data to be transmitted or, respectively, that converts received, QPSK-modulated data into GFSK-modulated data and gives them to the controller (23).
2. Mobile radiotelephone device according to claim 1, characterized in that
  - 10 the adaptor module (23) outputs a synchronization signal to the controller (22) in the synchronized conditions.
3. Mobile radiotelephone device according to claim 1 or 2, characterized in that the controller is a DECT controller (22).
4. Mobile radiotelephone device according to one of the claims 1, 2 or 3,
  - 15 characterized in that the adaptor module (23) synchronizes to a received, QPSK-modulated signal.
5. Mobile radiotelephone device according to claim 4, characterized in that the adaptor module (23) time-shifts the synchronization signal for the controller (22) dependent on its synchronization onto the QPSK-modulated signal.
6. Mobile radiotelephone device according to one of the preceding claims,
  - 20 characterized in that the adaptor module (23) drives an RF module (4, 5) such that the data are modulated onto a carrier frequency  $f_x$  that lies outside the DECT band.
7. Mobile radiotelephone device according to claim 6, characterized in that the carrier frequency  $f_x$  lies in a 2.4 GHz band.
8. Mobile radiotelephone device according to one of the preceding claims,
  - 25 characterized in that the adaptor module is an ASIC (23).
9. Mobile radiotelephone device according to one of the preceding claims, characterized in that the adaptor module (23) converts GFSK-modulated data into  $\pi/4$  QPSK-modulated data or, respectively, converts received  $\pi/4$  QPSK-modulated data
  - 30 into GFSK-modulated data.

10. Method for the wireless transmission of QPSK-modulated data with a controller (22) that is designed for a transmission of GFSK-modulated data, whereby an adaptor module (23) converts GFSK-modulated data output by the controller (22) into QPSK-modulated data to be transmitted or, respectively, converts received,  
 5 QPSK-modulated data into GFSK-modulated data and gives them to the controller (23).

11. Method for the wireless transmission of QPSK-modulated data according to claim 10, characterized in that the adaptor module (23) outputs a synchronization signal to the controller (22) in the synchronized condition.

10 12. Method according to claim 11, characterized in that the controller is a DECT controller (22).

13. Method according to one of the claims 11 or 12, characterized in that the adaptor module (23) synchronized itself from a received, QPSK-modulated signal.

15 14. Method according to claim 13, characterized in that the adaptor module (23) time-shifts the synchronization signal for the controller (22) dependent on its synchronization onto the QPSK-modulated signal.

15. Method according to according to one of the preceding claims, characterized in that the adaptor module (23) drives an RF module (4, 5) such that the data are modulated onto a carrier frequency  $f_x$  that lies outside the DECT band.

20 16. Method according to according to claim 15, characterized in that the carrier frequency  $f_x$  lies in a 2.4 GHz band.

17. Method according to according to one of the claims 10 through 16, characterized in that the adaptor module (23) converts GFSK-modulated data into  $\pi/4$  QPSK-modulated data or, respectively, converts received  $\pi/4$  QPSK-modulated data  
 25 into GFSK-modulated data.

18. Method according to one of the claims 10 through 17, characterized in that the carrier frequency  $f_x$  is changed after a predetermined time duration.

19. Method according to claim 18, characterized in that the carrier frequency  $f_x$  is changed after a time slot ( $Z_x$ ) or a frame of the transmission.



## Abstract

### Conversion of GFSK-Modulated Signals into QPSK-Modulated Signals

A DECT controller is employed for the transmission with a QPSK modulation method. To that end, an adaptor module (23) is provided that converts

5 QFSK-modulated data output by the DECT controller (22) into QPSK data to be transmitted. The adaptor module (23) can, for example, be an ASIC. Further, the adaptor module (23) can drive an RF module (4, 5) of the DECT controller (23) such that the data, for example, are modulated onto a carrier frequency in the 2.4 GHz ISM band. A system can thus be created for the 2.4 GHz ISM band that can meet the

10 demands (FCC part 15) made of this band in that a QPSK modulation is employed and the carrier frequency is changed after a predetermined time span (frequency hopping spread spectrum system). At the same time, a standard DEC^ controller can be employed in a cost-beneficial way.

Figure 5

FIG 1

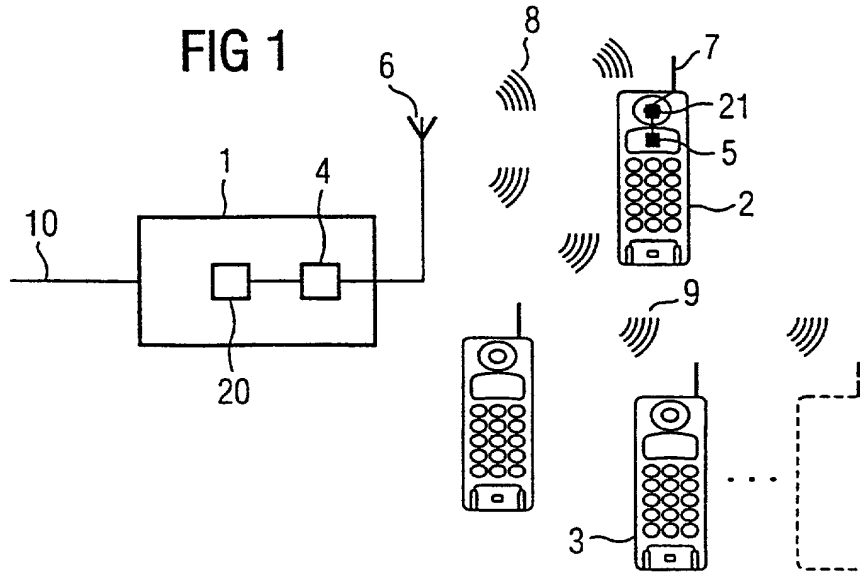


FIG 2

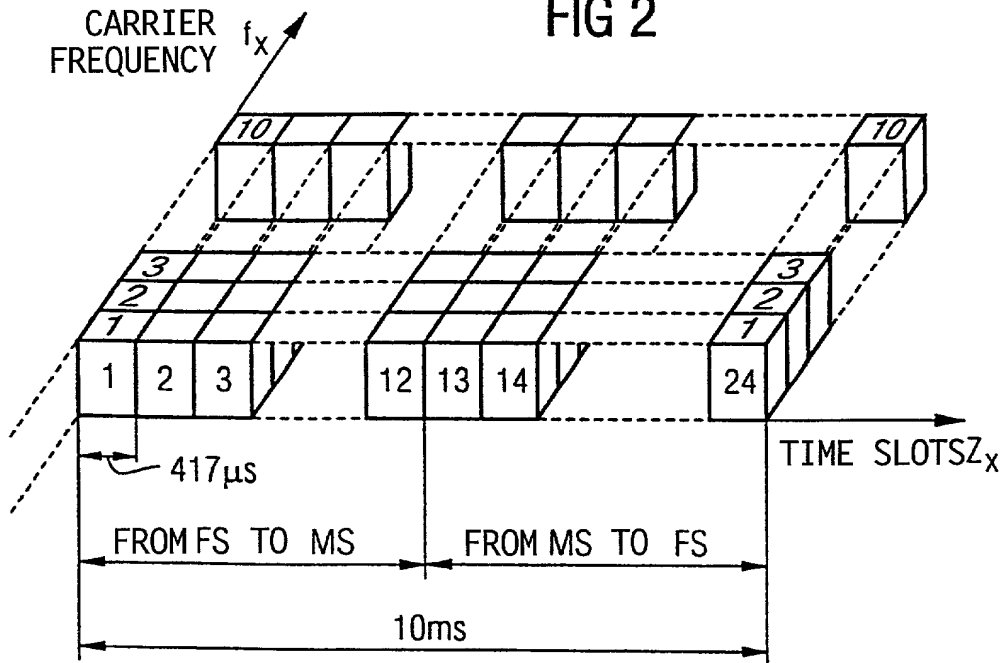


FIG 3

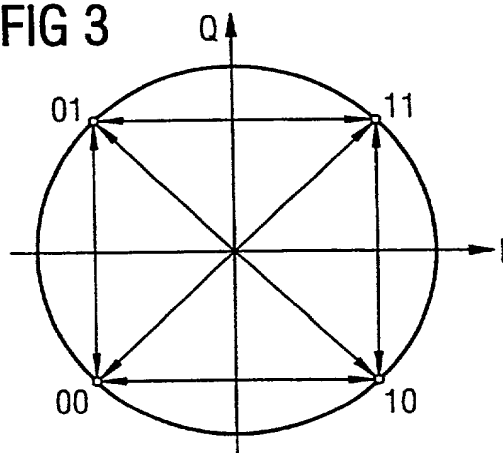
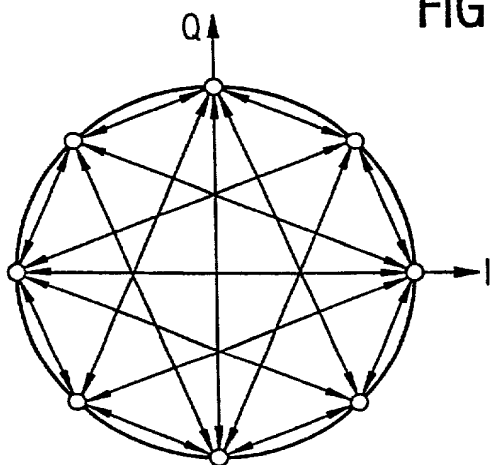


FIG 4



Data symb.	Phase Mod.
11	- 135°
10	- 45°
01	+ 135°
00	+ 45°

FIG 5

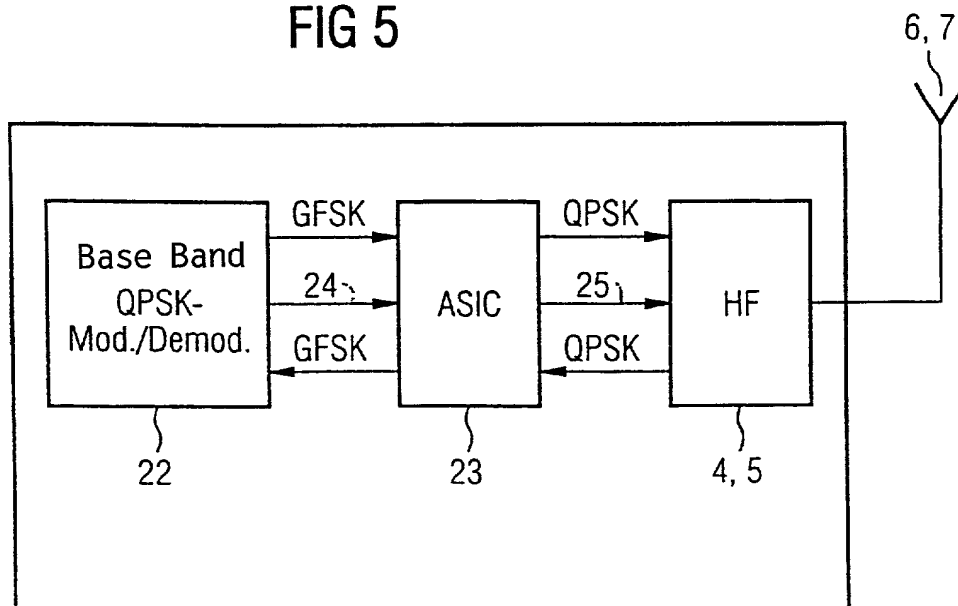
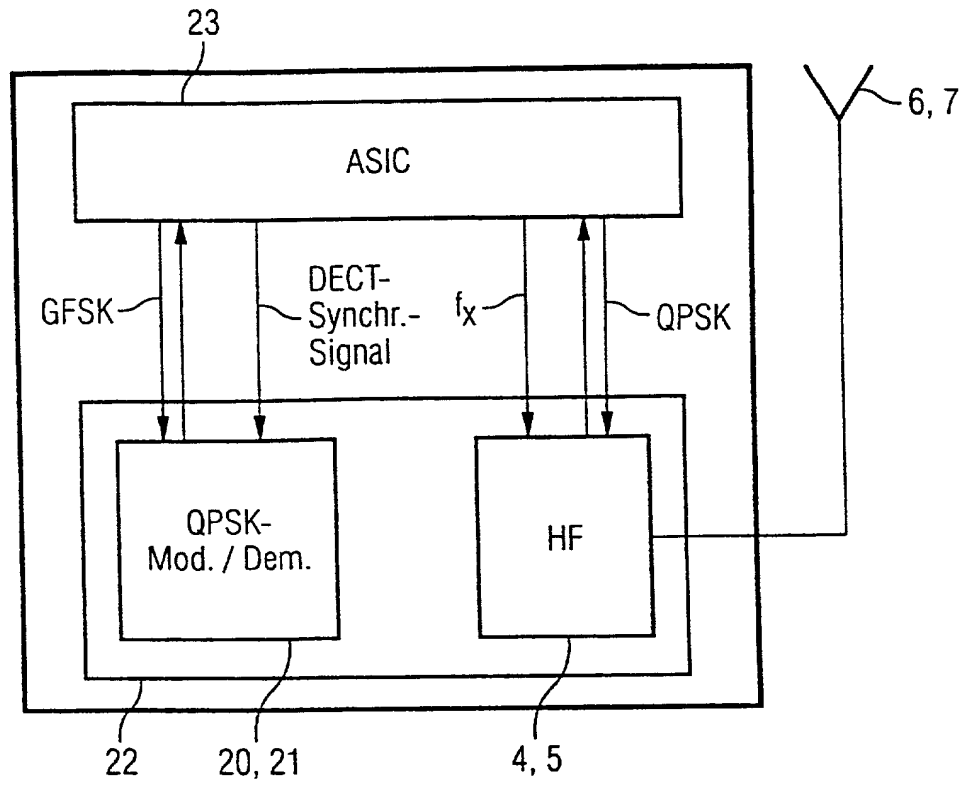


FIG 6



**Declaration and Power of Attorney For Patent Application****Erklärung Für Patentanmeldungen Mit Vollmacht****German Language Declaration**

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

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Umsetzung von GFSK-modulierten Signalen  
in QPSK-modulierte Signale

deren Beschreibung

(zutreffendes ankreuzen)

☒ hier beigefügt ist.

☐ am \_\_\_\_\_ als

PCT internationale Anmeldung

PCT Anwendungsnummer \_\_\_\_\_

Eingereicht wurde und am \_\_\_\_\_

Abgeändert wurde (falls tatsächlich abgeändert).

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Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

the specification of which

(check one)

☐ is attached hereto.

☐ was filed on \_\_\_\_\_ as

PCT international application

PCT Application No. \_\_\_\_\_

and was amended on \_\_\_\_\_  
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

# German Language Declaration

Prior foreign applications  
Priorität beansprucht

Priority Claimed

198 44 165.7 Germany 25. September 1998  
(Number) (Country) (Day Month Year Filed)  
(Nummer) (Land) (Tag Monat Jahr eingereicht)

☒ ☐  
Yes No  
Ja Nein

198 44 097.9 Germany 25. September 1998  
(Number) (Country) (Day Month Year Filed)  
(Nummer) (Land) (Tag Monat Jahr eingereicht)

☒ ☐  
Yes No  
Ja Nein

(Number) (Country) (Day Month Year Filed)  
(Nummer) (Land) (Tag Monat Jahr eingereicht)

☐ ☐  
Yes No  
Ja Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

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(Application Serial No.)  
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(patentiert, anhängig,  
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(Status)  
(patented, pending,  
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(Application Serial No.)  
(Anmeldeseriennummer)

(Filing Date)  
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(Status)  
(patented, pending,  
abandoned)

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## German Language Declaration

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**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

And I hereby appoint

Messrs. John D. Simpson (Registration No. 19,842) Lewis T. Steadman (17,074), William C. Stueber (16,453), P. Phillips Connor (19,259), Dennis A. Gross (24,410), Marvin Moody (16,549), Steven H. Noll (28,982), Brett A. Valiquet (27,841), Thomas I. Ross (29,275), Kevin W. Guynn (29,927), Edward A. Lehmann (22,312), James D. Hobart (24,149), Robert M. Barrett (30,142), James Van Santen (16,584), J. Arthur Gross (13,615), Richard J. Schwarz (13,472) and Melvin A. Robinson (31,870), David R. Metzger (32,919), John R. Garrett (27,888) all members of the firm of Hill, Steadman & Simpson, A Professional Corporation.

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A Professional Corporation  
85th Floor Sears Tower, Chicago, Illinois 60606

Voller Name des einzigen oder ursprünglichen Erfinders:		Full name of sole or first inventor:	
<b>SYDON, Uwe</b>			
Unterschrift des Erfinders <i>Uwe Sydon</i>	Datum 3.11.99	Inventor's signature	Date
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Staatsangehörigkeit Bundesrepublik Deutschland		Citizenship	
Postanschrift Amsterdamerstr. 32 D-40474 Düsseldorf Bundesrepublik Deutschland		Post Office Address	
Voller Name des zweiten Miterfinders (falls zutreffend):		Full name of second joint inventor, if any:	
<b>KOCKMANN, Jürgen</b>			
Unterschrift des Erfinders <i>Jürgen Kockmann</i>	Datum 3.11.99	Second Inventor's signature	Date
Wohnsitz D-48599 Gronau-Epe, Germany		Residence	
Staatsangehörigkeit Bundesrepublik Deutschland		Citizenship	
Postanschrift Oststr. 52 D-48599 Gronau-Epe Bundesrepublik Deutschland		Post Office Address	

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).



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UNDER THE PATENT COOPERATION TREATY--CHAPTER II

APPLICANT(S): UWE SYDON ET AL  
ATTORNEY DOCKET NO.: P01,0018  
INTERNATIONAL APPLICATION NO: PCT/DE99/03057  
INTERNATIONAL FILING DATE: 23 SEPTEMBER 1999  
INVENTION: CONVERSION OF GFSK-MODULATED SIGNALS INTO  
QPSK-MODULATED SIGNALS

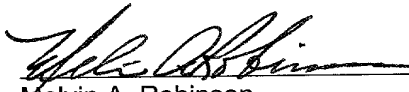
Assistant Commissioner for Patents,  
Washington D.C. 20231

**APPOINTMENT OF ASSOCIATE POWER OF ATTORNEY**

Dear Sir:

I am an attorney designated on the Power of Attorney for the above-referenced application. I hereby appoint Mark Bergner (Reg. No. 45,877) as an associate attorney, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Submitted by,

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